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(54) Decontamination of swimming pool water

(57) The treatment of swimming pool water 2 in order to remove contaminants comprises the steps of removing a flow of water 5 from the pool, passing the water through a particulate filtration plant 6, drawing off a fraction 11 of the filtrate whilst passing the remainder back into the pool, introducing ozone 13 into the fraction, passing the fraction into an ozone contact chamber 15, exposing the ozonised water to ultraviolet radiation and subsequently returning the fraction to the pool. The ozone contact chamber may consist of two concentric tanks (16 and 17, Fig 2). Preferably exposure to ultraviolet radiation occurs within the inner tank (17, Fig 2) of the ozone contact chamber, the radiation source being a set of light tubes (18, Fig 3). Alternatively the UV light source (24, Fig 4) may be arranged along an outlet pipe leading from the contact chamber. Preferably the radiation both accelerates biodegradation and breaks down the ozone.

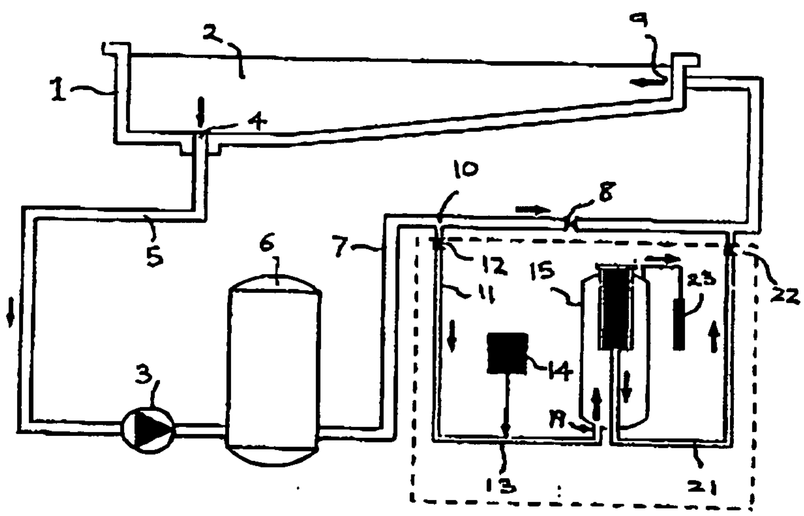

FIGURE 1

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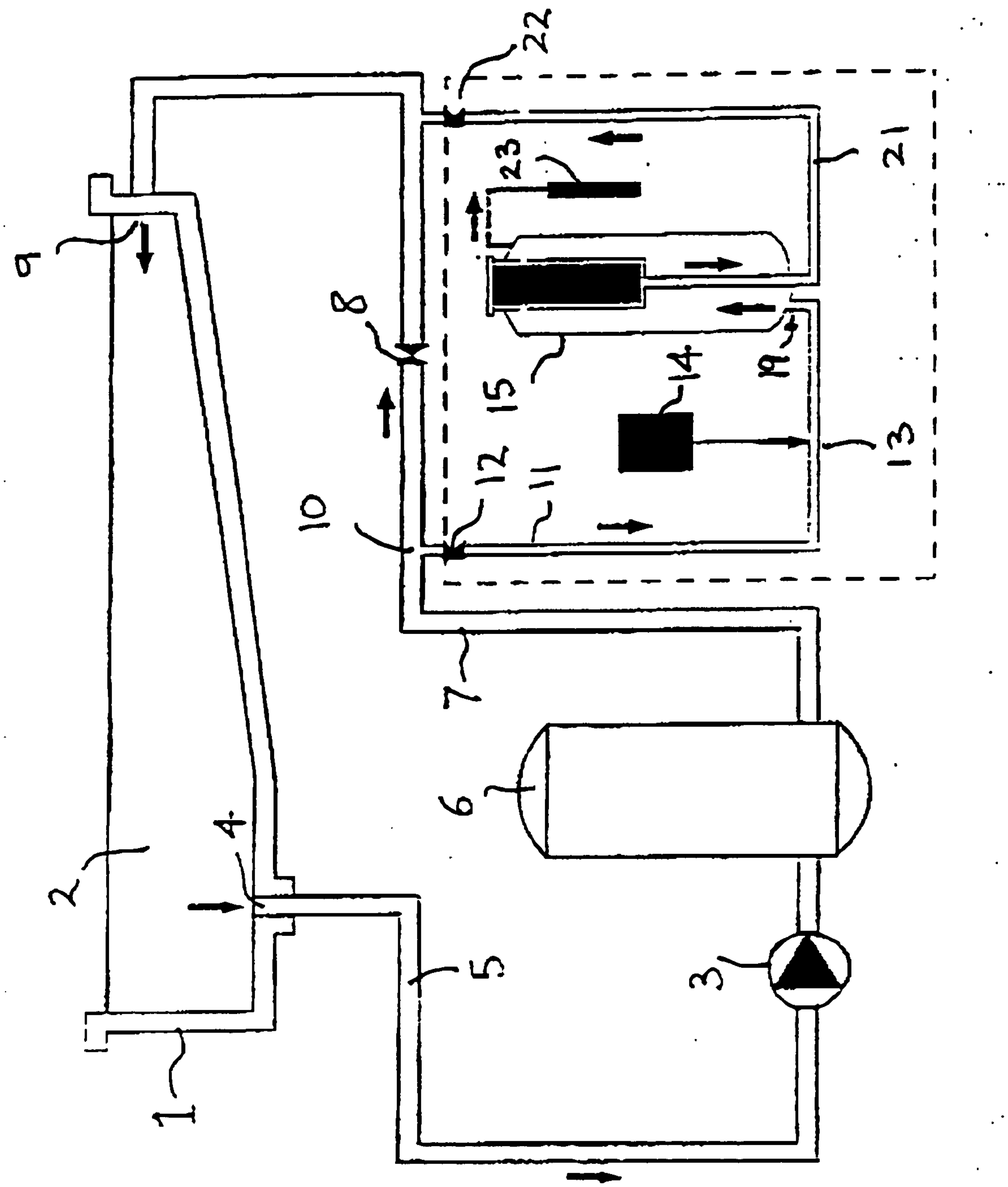


FIGURE 1

2|3

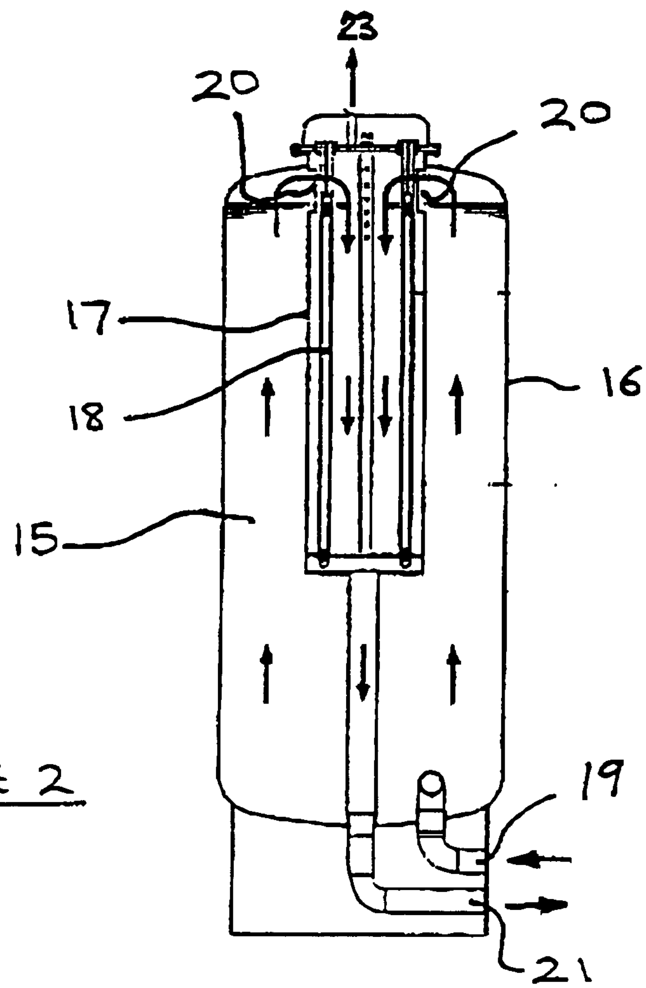
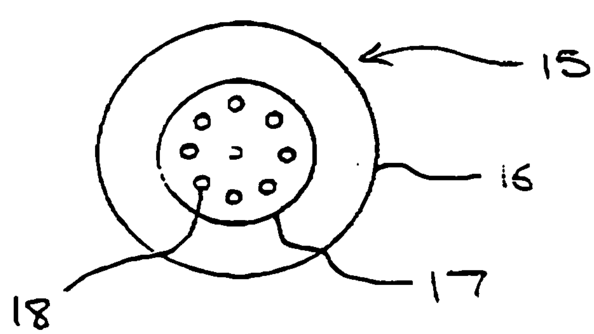


FIGURE 2

FIGURE 3



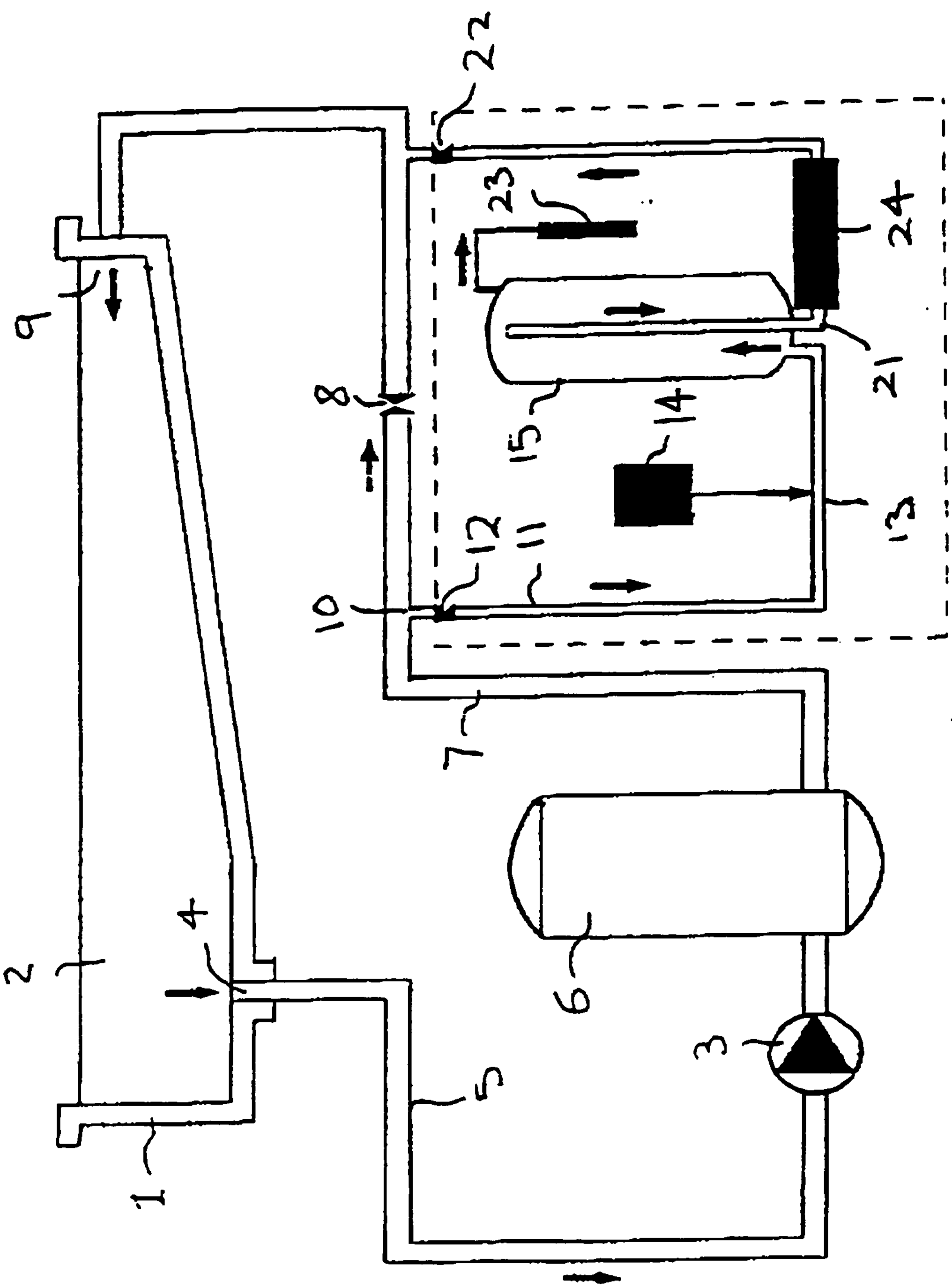


FIGURE 4

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WATER PURIFICATION

The present invention relates to a method and apparatus for purifying water contained in a swimming pool.

The traditional method of reducing contamination levels in swimming pool water is to dose the water with sodium hypochlorite, the presence of chlorine in the water reducing the risk of cross-infection occurring between bathers. Typically, the pool water is also recycled through a filtration plant to remove particulate material from the water.

It is known to replace or supplement chlorine dosing with an ozonisation process in which ozone is introduced into the recycled water flow or a portion thereof (the so called "slipstream" process). Ozone is a highly reactive compound and oxidises many organic pollutants present in water rendering them harmless. In order to improve the efficiency of the ozonisation process, following introduction of the ozone into the water, the water is passed through a "contact" chamber where it is held for approximately two minutes (the "dwell time") in order to allow the ozone time to react with the pollutants. Upon exiting the contact tank, the ozonised water is normally passed down through a carbon bed filter in order to remove the ozone: it being normal to maintain the level of ozone present in the water contained in the swimming pool at below 0.05ppm because at greater levels it is harmful to bathers.

Where the ozonisation process is used in combination with chlorination, it is found that the carbon bed causes

chlorine to be stripped out of the water. It is thus necessary to replenish the level of chlorine present in the water, resulting in increased expense. Furthermore, because the water directly beneath the carbon bed filter does not contain a sufficiently high level of chlorine there is a significant risk of bacteria growth in this area.

It is an object of the present invention to overcome or at least mitigate disadvantages of known swimming pool ozonisation decontamination systems.

It is a second object of the present invention to eliminate the need for a carbon filter from swimming pool ozonisation decontamination systems.

It is a further object of the present invention to improve the effectiveness of existing swimming pool ozonisation systems.

According to a first aspect of the present invention there is provided a method of treating water contained in a swimming pool to remove contaminants from the water, the method comprising the steps of:

drawing a water flow from the swimming pool;

passing the water through a filtration plant to remove particulate contaminants;

drawing off a fraction of the water flow after filtration whilst returning the remainder of the flow to the swimming pool;

introducing ozone into said fraction;

passing the fraction through an ozone contact chamber;

exposing the ozonised fraction to ultra-violet radiation; and

returning the fraction to the swimming pool.

By exposing the ozonised water to ultra-violet radiation, the oxidation of some substances can be accelerated. Thus, the oxidation of pollutants takes place more quickly than with conventional ozonisation systems and the time for which the water must be held in the ozone chamber can be reduced. This allows a smaller ozone contact chamber to be utilised. Furthermore, because the ultra-violet radiation quickly breaks down the ozone, and the break-down products are rapidly consumed, the ozone is substantially destroyed before the ozone-treated water reenters the swimming pool. Thus there is no need to filter the ozone-treated water through a carbon filter bed and no significant loss of chlorine occurs.

Preferably, the level of ozone introduced into the water fraction is in the range 0.25% to 3% by weight. In one example it is 0.75% and in another example it is 1.5% by weight.

Preferably, the ultra violet radiation is in the 200 to 300 nanometres waveband and the highest dose is of the order 250 milliwatt seconds/cm^2 within the U.V. chamber.

Preferably, said fraction comprises 5 to 50% of the water flow drawn from the swimming pool and more preferably is approximately 15%.

In a first embodiment of the present invention, the ozonized water is exposed to ultra-violet radiation as it

passes through the ozone contact chamber. In an alternative embodiment of the invention the ozonized water is exposed to ultra-violet radiation following its exit from the contact chamber.

According to a second aspect of the present invention there is provided a water purification system for purifying water contained in a swimming pool, the system comprising;

pump means for drawing a water flow from the pool;

a filtration plant for filtering the water flow to remove particulate contaminants;

valve means for drawing off a fraction of the water flow following its exit from the filtration plant whilst allowing the remainder to be returned to the swimming pool;

an ozone generator and means for introducing generated ozone into said fraction of the water flow;

an ozone contact chamber for receiving the ozonised water;

an ultra-violet light source arranged to expose the ozonized water to ultra-violet radiation; and

means for subsequently returning the water fraction to the swimming pool.

Preferably, the system does not comprise a carbon filter bed for removing ozone from said fraction of water.

In one embodiment of the invention, the ultra-violet light source is contained within the ozone contact chamber. The ozone contact chamber may comprise a substantially cylindrical tank made of stainless steel, the ultra-violet light source comprising a single or set of ultra-violet

light tubes arranged around the inner surface of the tank which is polished to enhance reflection, with the ozonized water fraction passing through the tank in a generally axial direction. More preferably, the tank is mounted concentrically within a second, outer, tank also made of stainless steel into which the flow is introduced to increase its dwell time in the contact chamber. The ozonized water fraction flows in a first axial direction through the outer tank and through the inner tank in the opposite axial direction before exiting the chamber. Preferably, the chamber is arranged so that it takes water less than 2 minutes, and more preferably 1 minute or less, to flow through the contact chamber.

In a further embodiment of the invention, the ultra-violet light source is arranged in an outlet pipe from the contact chamber.

For a better understanding of the present invention and in order to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a schematic diagram of a swimming pool purification system embodying the present invention;

Figure 2 shows in detail a vertical section through an ozone contact chamber of the system of Figure 1;

Figure 3 shows a horizontal cross-section through the ozone contact chamber of Figure 2; and

Figure 4 shows a schematic diagram of a swimming pool purification system according to an alternative embodiment

of the present invention.

Figure 1 shows a swimming pool 1 which contains a body of water 2. In general, especially in the case of larger swimming pools, the water will contain chlorine in order to reduce the risk of cross-infection between bathers. A fixed amount of water is continually withdrawn from the swimming pool by a main circulating pump 3 via a swimming pool outlet 4 and a pipe 5. The pump outlet is connected to a filtration plant 6 of known design (e.g. a sand-bed filter) which removes particulate material from the water. The outlet pipe 7 from the filtration plant is connected via a supply control valve 8 to a swimming pool water inlet 9 to enable recycled water to be returned to the swimming pool.

At a point 10 along the length of the filtration plant outlet pipe 7, a fraction of the main water flow is drawn off by way of a pipe 11 and a further control valve 12. In the region of 5 to 50% of the main water flow passes through the pipe 11 to an ozone gas introduction point 13. The ozone gas is provided by an ozone generator 14. The ozonised water is then supplied to an ozone contact chamber 15 where it is held for a sufficient duration to allow the ozone to react with pollutants.

The ozone contact chamber 15 is shown in more detail in Figures 2 and 3 and comprises outer and inner concentrically arranged generally-cylindrical tanks 16, 17. An off-gas destruct unit 23 is provided for preventing any build up of non-dissolved gas in the contact chamber and

for destructing any such gas. Arranged around the inner periphery of the inner tank 17 is a set of ultra-violet emitting light tubes 18 which are isolated from contact with water by being housed in quartz sleeves. Quartz is of course UV transmissive. Typically eight ultra-violet tubes are used as shown in Figure 3. The tubes operate in the 200 to 300 nanometres range with a power output in the range 25 to 250 milliwatt second/cm^2. The tank 17 typically has a limited diameter of the order of 250mm which ensures that all of the water flow through the tank 17 is adequately irradiated by the UV radiation despite its attenuation in water.

Ozonised water flows into the ozone contact chamber via an inlet 19 and passes up through the space between the inner and outer tanks, flowing into the inner tank 17 via openings 20. The water then flows down through the inner tank 17, where it is exposed to ultra-violet radiation, and then out of the contact chamber 15 via outlet pipe 21. The dimensions of the chamber 15, and the flow rate of water into and out of the ozone chamber, are such that the ozonised water takes approximately 1 minute to pass completely through the chamber where a two step oxidative degradation of pollutants occurs; the first step being oxidation due to the presence of ozone in the outer tank 16 and the second step being photo-chemically UV-induced cleavage of ozone and subsequent production of highly reactive hydroxyl radicals in the inner tank 17. Thus, due to the UV, not only is the rate of oxidation of pollutants

increased, but the ozone present in the water is almost completely destroyed before the water exits from the ozone contact chamber. It is estimated that the oxidation rates with this combined ultra-violet ozone treatment are 10 to 1000 times faster than with ozone treatment alone.

As a result of the increased oxidation rate, the contact time required between the ozone and the contaminated water is reduced in comparison to conventional ozonisation system contact chambers. Thus, the ozone contact chamber 15 can be made considerably smaller, helping to offset the additional cost of the ultra-violet lamps.

Referring again to Figure 1, the outlet pipe 21 from the contact chamber is coupled via a control valve 22 back to the main pipe 7. From there, the purified water is then mixed back with the main filtered supply and is fed into the swimming pool via the pool inlet 9. The water flow rate through the recycling system, and the fraction of this flow which is subjected to ozonization, are selected to ensure that the purity of the pool water is maintained at a satisfactory level.

It will be appreciated that various modifications may be made to the above described embodiment without departing from the scope of the present invention. One such modification is shown in Figure 4, where an ultra-violet light source 24 is arranged in the outlet pipe 21 from the contact chamber, replacing the in-chamber source formed by tank 17 and light tubes 18 of Figure 1. One advantage of

this system is that the UV light source could be retro-fitted into existing slipstream purification systems.

Another such modification would be to utilise a single high intensity medium or low pressure mercury vapour U.V. light source as an alternative to the multiple low pressure mercury lamps referred to above.

CLAIMS:

1. A method of treating water contained in a swimming pool to remove contaminants from the water, the method comprising the steps of:

drawing a water flow from the swimming pool;

passing the water through a filtration plant to remove particulate contaminants;

drawing off a fraction of the water flow after filtration whilst returning the remainder of the flow to the swimming pool;

introducing ozone into said fraction;

passing the fraction through an ozone contact chamber;

exposing the ozonised fraction to ultra-violet radiation; and

returning the fraction to the swimming pool.

2. A method according to claim 1, wherein the level of ozone introduced into the water fraction is in the range 0.25% to 3% by weight.

3. A method according to claim 1 or 2, wherein the ultra violet radiation is in the 200 to 300 nanometres waveband.

4. A method according to any one of the preceding claims, wherein said fraction comprises 5 to 50% of the water flow drawn from the swimming pool.

5. A method according to any one of the preceding claims, wherein the ozonized water is exposed to ultra-violet radiation as it passes through the ozone contact chamber.

6. A method according to any one of claims 1 to 4,

wherein the ozonized water is exposed to ultra-violet radiation following its exit from the contact chamber.

7. A method of treating water contained in a swimming pool substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings or those Figures as modified by Figure 4.

8. A water purification system for purifying water contained in a swimming pool, the system comprising;

pump means for drawing a water flow from the pool;

a filtration plant for filtering the water flow to remove particulate contaminants;

valve means for drawing off a fraction of the water flow following its exit from the filtration plant whilst allowing the remainder to be returned to the swimming pool;

an ozone generator and means for introducing generated ozone into said fraction of the water flow;

an ozone contact chamber for receiving the ozonised water;

an ultra-violet light source arranged to expose the ozonized water to ultra-violet radiation; and

means for subsequently returning the water fraction to the swimming pool.

9. A system according to claim 8, wherein the system does not comprise a carbon filter bed for removing ozone from said fraction of water.

10. A system according to claim 8 or 9, wherein the ultra-violet light source is contained within the ozone contact chamber.

11. A system according to claim 10, wherein the ozone contact chamber comprises a substantially cylindrical tank, the ultra-violet light source comprising a set of ultra-violet light tubes arranged around the inner surface of the tank which is polished to enhance reflection, with the ozonized water fraction being arranged to pass through the tank in a generally axial direction.

12. A system according to claim 11, wherein the tank is mounted concentrically within a second outer tank into which the flow is introduced to increase its dwell time in the contact chamber, the ozonized water fraction being arranged to flow in a first axial direction through the outer tank and through the inner tank in the opposite axial direction before exiting the chamber.

13. A system according to claim 8 or 9, wherein the ultra-violet light source is arranged in an outlet pipe from the contact chamber.

14. A water purification system, substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings or those Figures as modified by Figure 4.

CHARTER MARK

The Patent Office

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Application No: GB 9621483.8
Claims searched: 1-14

Examiner: Gavin Dale
Date of search: 16 January 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): C1C

Int Cl (Ed.6): C02F 1/00, 1/32, 1/78, 9/00

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2205935A	(YASUNOBU YOSHIDA) See Fig 1 and page 8 column 3 to page 9 column 1	1,8
A	US 4959142	(DEMPO) See column 2 lines 24-26 and lines 29-33	1,8

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.